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NEW DELHI 110002

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SPECIFICATION FOR BUILT-UP MICA FOR ELECTRICAL PURPOSES

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Indian Standard

SPECIFICATION FOR BUILT-UP MICA FOR ELECTRICAL PURPOSES

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 31 July 1963, after the draft finalized by the Insulating Materials Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 Use of built-up mica as an electrical insulating material in this country is increasing. To cater for this need, the built-up mica manufacturing industry has also been started and is expanding. With a view to providing necessary technical data and to bringing about uniformity in requirements, methods of testing, etc, this standard has been prepared.

0.3 Temperature stability is an important characteristic of built-up mica. However, the values of temperature and pressure which the built-up mica intended for different applications has to withstand, are not yet experimentally confirmed. For the present, therefore, these values have been omitted from the standard but have been left to be agreed to between the supplier and the purchaser (*see* **5.1**). It is hoped that specific values will very soon be available for incorporation in the standard.

0.4 In preparing this standard, assistance has been derived from the following:

DIN 57332 : 1949 RULES FOR MICA PRODUCTS AS INSULATING MATERIALS — ELECTROTECHNOLOGY. Deutscher Normenausschuss.

B.S. 626 : 1946 MICANITE FOR COMMUTATOR SEPARATORS. British Standards Institution.

NEMA PUB. No. ME1-1956 MANUFACTURED ELECTRICAL MICA. National Electrical Manufacturers' Association. United States of America.

0.5 Wherever a reference to any Indian Standard appears in this specification, it shall be taken as a reference to the latest version of the standard.

0.6 Metric system has been adopted in India and all quantities and dimensions appearing in this standard have been given in this system.

0.7 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960 Rules for Rounding Off Numerical Values (*Revised*). The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

0.8 This standard is intended chiefly to lay down the requirements and methods of test for built-up mica, and it does not include all the necessary provisions of a contract.

1. SCOPE

1.1 This standard specifies the physical and electrical requirements and methods of test for built-up mica in the following forms:

a) Flexible plate,
b) Heater plate,
c) Commutator (segment) plate,
d) Moulding plate,
e) Folium, and
f) Tape.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Flexible Plate — Consists of binder and mica splittings made in the form of sheets with such flexibility as will permit winding or wrapping into place without heating. These plates may or may not contain reinforcing material, such as paper, cloth, etc.

2.2 Heater Plate — Made with mica splittings and binder in the form of hard rigid plate used in electrical heating devices.

2.3 Commutator (Segment) Plate — Made in the same way as the built-up mica heater plate but ground or sanded to uniform thickness.

2.4 Moulding Plate — Consists of layers of mica splittings and binder and made to form a hard rigid plate designed for moulding or forming under heat and pressure.

2.5 Folium — Consists of one or more layers of mica stuck on insulating kraft paper or any other thin insulating material with a binder. These are generally made in long lengths and supplied in rolls.

2.6 Tapes — Are composed of binder and mica splittings with reinforcement on one or both sides and manufactured in the form of rolls.

3. MATERIAL

3.1 Mica — Built-up mica shall be made either out of muscovite mica splittings or phlogopite (amber) mica splittings as required. Mica splittings shall be sound, clean and free from mineral inclusions. If any limitation of the size of the splittings and their quality is required, it shall be agreed to between the purchaser and the supplier. The size of the splittings shall be determined as described in Appendix A.

3.2 The finished surface shall be reasonably smooth and free from excess binder and loosened mica and shall not be tacky.

3.3 Bond Content — The bond content as determined by the method given in Appendix B shall not exceed the limit prescribed in Table I.

TABLE I PHYSICAL REQUIREMENTS OF BUILT-UP MICA

SL No.	FORM	REINFORCING MATERIAL	NOMINAL THICKNESS	TOLERANCE		BOND CONTENT, *Max*	ELECTRIC STRENGTH kV/mm
				Average	Individual		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			mm	mm	mm	Percent	
1	Flexible Plate	None, Paper, Cellophane, Cloth, Silk	0·15 0·20 0·25	+0·08 −0·03	+0·18 −0·08	20	20
			0·40	±0·08	+0·20 −0·13		
2	Heater Plate	None	0·25 0·40	±0·08	+0·18 −0·13	4	20
3	Commutator (Segment) Plate	None	0·25 0·40	±0·03	±0·05	7	25
4	Moulding Plate	None, Paper	0·20 0·25 0·40	±0·05	±0·08	18	25
5	Mica Folium	Kraft Paper	0·15 0·20 0·25	±0·08	+0·13 −0·09	25	12
6	Tape	Cellophane, Paper, Cloth, Silk, Glass, Fabric	0·10 to 0·20 0·25	±0·05	+0·13 −0·05	30	12

4. DIMENSIONS

4.1 Thickness — The thickness shall be determined by means of a suitable micrometer. Ten readings shall be taken over the entire area of a sheet or plate and over any 1·5 metre length of the tape. The maximum, minimum and average values shall be reported.

4.1.1 The thickness at any part of the material, when determined as above shall be within the limits corresponding to the nominal thickness specified in Table 1.

4.2 Width of Tape — The nominal values of width shall be 15, 20 and 25 mm. The width shall not vary at any place by more than ±1 mm from the nominal value.

5. PHYSICAL REQUIREMENTS

5.1 Temperature Stability — When the material is subjected to the combined effect of pressure and temperature agreed to between the supplier and the purchaser for 10 minutes, it shall show no signs of slipping of mica splittings, exudation of bond or deformation of any kind.

5.2 Tensile Strength of Tape — The minimum tensile strength of tapes, with reinforcing materials, shall be 2 kg/cm of width. Any suitable testing machine may be used but the jaws shall be set 25 cm apart initially and separated at the rate of 5 cm per minute.

5.3 Test for Mouldability for Moulding Plate Up to 2·5 mm Thickness — Test specimens of moulding sheet, 50 mm wide and sufficiently long to form a butt joint round a mandrel of 50 mm diameter, shall be heated at 100 to 150°C until they become flexible, rolled round the mandrel while still flexible and then allowed to cool. When both come to the room temperature and the mandrel is taken out, mica splittings shall not protrude from the test specimen and the variation in the internal diameter of the moulded ring shall be within ±0·25 mm.

5.4 Test for Flexibility — Strips of flexible plates, 50 × 300 mm in size, shall be wound tightly round a rod of 25 mm square cross-section. The edges of the rods used shall be rounded to a curvature of 1·0 mm for sheets of thickness 0·25 mm or lower and 1·6 mm for sheets of thickness above 0·25 mm. Five minutes after winding, the rod shall be removed, and the inner surface of the test specimen shall show no sign of cracking or loosening of the splittings.

5.5 Electric Strength — All built-up mica products shall withstand the voltage specified in col 8 of Table 1. The test shall be carried out in accordance with Appendix C for all products except mica tape for which the test procedure shall be as specified in **5.1.3** of IS : 2584 - 1963 Method of Test for Electric Strength of Solid Insulating Materials at Power Frequencies.

5.6 Storage Life — The supplier shall specify, when required by the purchaser, the storage life of the material under specified conditions.

6. SAMPLING

6.1 Lot — In any consignment, all the units of built-up mica of the same form and same nominal thickness manufactured under similar conditions of production shall be grouped together to constitute a lot.

6.2 The number of samples to be selected at random from the lot shall depend upon its size and shall be in accordance with col 1 and 2 of Table II.

TABLE II SAMPLE SIZE

LOT SIZE (1)	NUMBER OF SAMPLES TO BE SELECTED (2)
Up to 200	3
201 „ 300	4
301 „ 500	5
501 „ 800	6
801 „ 1 300	8
1 301 and above	10

6.3 Number of Tests

6.3.1 All the samples selected as in **6.2** shall be tested for bond content (*see* **3.3**), thickness (*see* **4.1**), temperature stability (*see* **5.1**) and breakdown strength (*see* **5.5**).

6.3.2 The tapes shall also be tested for tensile strength (*see* **5.2**), moulding plates for mouldability test (*see* **5.3**), and flexible plates for flexibility tests (*see* **5.4**).

6.4 Criterion for Conformity

6.4.1 The lot shall be considered as conforming to the requirements of this specification if all the samples tested satisfy the corresponding requirements of the test. If more than one sample fails in any test(s), the lot shall be considered as not conforming to the requirements of the specification.

6.4.2 If only one sample fails in any particular test(s), twice the number of samples tested shall be selected at random from the lot and subjected to the test(s) in which failure has occurred. The lot shall be considered as conforming to the requirements of the specification, if all the units so tested satisfy the corresponding requirements of the test.

APPENDIX A

(*Clause* 3.1)

METHOD OF DETERMINATION OF SIZE OF SPLITTINGS

A-1. The size of the sample of sheet to be tested shall be 300 × 300 mm.

A-2. To remove the bonding material, the sample shall be placed in a tray or shallow bath and boiled with a 15 percent aqueous solution of caustic potash (KOH) until disintegration takes place. If the bond cannot be loosened by the above means, any other suitable solvent may be used. Alternatively, the splittings may be removed mechanically provided no splitting is torn in the process.

A-3. After disintegration, the splittings shall be washed several times with hot water and then allowed to dry. They shall be graded on a suitable template corresponding to the size of the splittings.

APPENDIX B

(*Clause* 3.3)

METHOD OF DETERMINATION OF BOND CONTENT

B-1. BUILT-UP MICA WITHOUT REINFORCEMENT

B-1.1 Take 5 to 10 g of the material from different portions of a representative sample and dry for 10 minutes at 130°C in a convection oven. Place the dried material in the crucible, weigh and heat in a muffle furnace at 525 ± 25°C for 30 minutes. After cooling in a desiccator, weigh, and again heat the crucible in a muffle furnace as before for half an hour, cool and weigh. If the second weighing does not agree with the first to within 3 mg, repeat the process of heating, cooling and weighing. The final loss in weight expressed as a percentage shall be taken as the bond content.

B-2. BUILT-UP MICA WITH REINFORCEMENT

B-2.1 When the bond is known to be soluble in a low boiling solvent which has no effect on the reinforcing material, weigh the dried material as in **B-1.1** in a previously dried and weighed thimble. Put a dry cotton plug over the material and extract in a Soxhlet extractor for 16 hours, the rate of extraction being two minutes for each cycle, that is, the time taken for one complete filling and emptying the siphon tube. The thimble is then taken out, dried and weighed. The extraction is continued for another 8 hours and the thimble dried and weighed again. The difference between the first and second weighings should be within 2 mg, thus giving an indication that the extraction is practically complete, otherwise the operation shall be continued for another 8 hours.

B-2.1.1 The percentage loss in weight shall be taken as the bond content.

B-2.1.2 Examples of typical solvents are ether, sulphuric acid, petroleum ether, acetone, alcohol, chloroform, etc.

B-2.2 If the bond cannot be dissolved, take a measured area of the sample, dry, weigh and ash as in **B-1.1**. Take a piece of the reinforcing material of exactly the same area, dry, weigh and ash as in the case of the material. Calculate the bond content from the following formula:

$$\text{Bond content} = \frac{(W_1 - w_1) - (W_2 - w_2)}{W_1 - W_2}$$

where

W_1 = weight of the dry material,
w_1 = weight of the ash of the material,
W_2 = weight of the dry reinforcement, and
w_2 = weight of the ash of the reinforcement.

APPENDIX C

(*Clause* 5.5)

METHOD OF TEST FOR ELECTRIC STRENGTH

C-1. GENERAL REQUIREMENTS

C-1.1 The size of the test piece shall not be less than 300 × 300 mm.

C-1.2 The bottom electrode shall consist of a flat disc of brass 75 mm diameter and 25 mm thick. The top electrode shall consist of a solid cylinder of brass 25 mm diameter and 25 mm high. The sharp edges shall be rounded to a radius of 3 mm.

C-1.3 Good contact shall be made between each electrode and the test piece. When the surface of the insulation is irregular or any difficulty is experienced in obtaining good contact, it is recommended that tinfoil should be interposed between the electrodes and the test piece.

C-1.4 The frequency of the supply should be approximately 50 c/s and, if different, its value shall be stated. The wave-shape shall be as nearly sinusoidal as possible, and the conditions of the test shall be such as to prevent any high-frequency oscillations.

C-1.5 The material shall be maintained at a temperature of 90°C in air during the test and for a period of 30 minutes before the test is applied.

C-2. 20-SECOND STEP TEST

C-2.1 The voltage shall be raised from zero at a uniform rate such that breakdown occurs on an average in between 10 and 20 seconds. This procedure requires some previous knowledge of the characteristics of the material or one or two preliminary tests.

C-2.2 The voltage nearest to 40 percent of the probable breakdown voltage as determined in **C-2.1**, shall be selected from Table III and applied to the test piece.

C-2.3 If the test piece withstands this voltage for 20 seconds without failure, the next higher and subsequent voltages in Table III shall each be successively applied for 20 seconds until failure occurs. The increases of voltage shall be made as quickly as possible and the time spent in raising the voltage shall be included in the period of 20 seconds at the higher voltage. The electric strength shall be the highest voltage which is withstood for 20 seconds without breakdown.

Note — This test should give approximately the same breakdown voltage as the steady voltage required to cause breakdown after application for one minute. If breakdown occurs in less than two minutes from the start of the test the result is likely to be higher than this one-minute value, and on subsequent tests a lower starting voltage may be desirable.

TABLE III SUCCESSIVE VOLTAGES TO BE APPLIED

(*Clauses* C-2.2 *and* C-2.3)

Kilovolts Peak $\sqrt{2}$

0·50	0·55	0·60	0·65	0·70	0·75	0·80	0·85	0·90	0·95					
1·0	1·1	1·2	1·3	1·4	1·5	1·6	1·7	1·8	1·9					
2·0	2·2	2·4	2·6	2·8	3·0	3·2	3·4	3·6	3·8	4·0	4·2	4·4	4·6	4·8
5·0	5·5	6·0	6·5	7·0	7·5	8·0	8·5	9·0	9·5					
10·0	11	12	13	14	15	16	17	18	19					
20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
50	55	60	65	70	75	80	85	90	95	100				
110	120	130	140	150	160	170	180	190	200					

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